

SCIENCESTARS

ISSUE 06

THE INFINITE JOURNEY
TO ASTRONOMY



science & technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

DST EVENTS

- World Space Week
- Africa Conference and Summit on Crystallography
- The CSIR Excellence Awards
- Indigenous Knowledge Systems Expo
- DST's Business Challenge Relay





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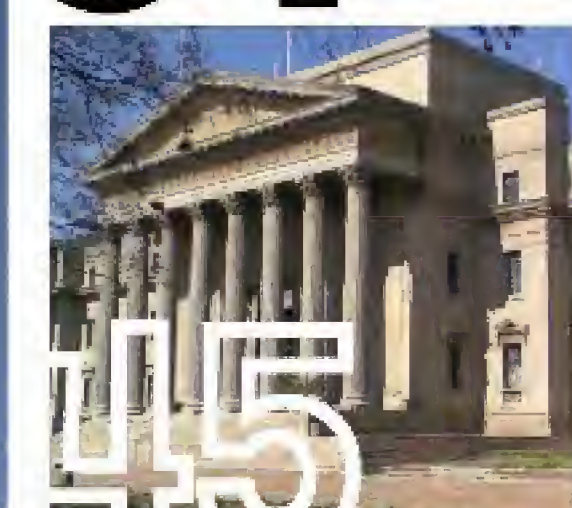
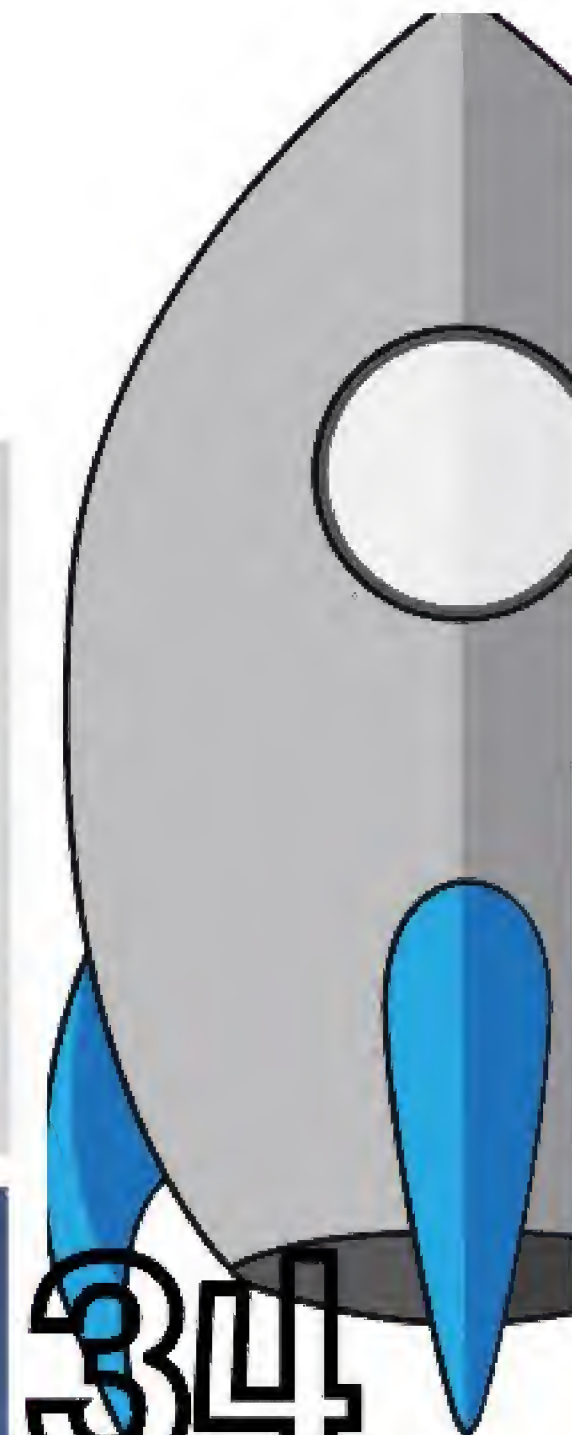
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THE FOREWORD

The key to the answers

Welcome to this special astronomy edition of Science Stars. In this issue you will find out more about the exciting projects and initiatives happening in astronomy in South Africa.

Over the last decade or so, astronomy in South Africa has grown enormously. The National Astrophysics and Space Science Programme was launched in 2003, the Southern African Large Telescope was completed in 2005 and South Africa was announced as the joint host of what will be the largest radio telescope in the world, the Square Kilometer Array, in 2012. These and other projects (such as the formation of the South African National Space Agency in 2010) are putting South Africa at the forefront of astronomical research in the world.

The science of astronomy seeks to answer fundamental questions about the universe we live in. Questions like: How big is the universe? How old is it? What is it made of? Do aliens exist? If you have ever looked at the night sky and wondered about the objects that you see, then you have already taken the first step towards answering these questions.

A career in astronomy gives you the opportunity to solve challenging problems, travel and work with a diverse range of people while learning more about the universe and our place in it. Here's hoping that these pages start you off on an exciting and rewarding journey to the stars!

Dr. Tana Joseph



" LETTER FROM THE EDITOR

ENJOY AND BE INSPIRED!



There are many sciences that interest and excite but perhaps the oldest is Astronomy. Most early civilisations such as the Babylonians, Greeks, Chinese, Indians, Iranians, Maya and closer to home Africans were great believers and admirers of Astronomy. They all sought to explore and get the meanings of events and the world around them through the stars. This leads us to our next question: What exactly is astronomy? Well my dear friends, Astronomy is the study of the sun, moon, stars, planets, comets, gas, galaxies, gas, dust and other non-earthly bodies and phenomena. In short we can describe Astronomy

as the study of stars, planets and space. While I was feasting on all the information available on Astronomy, I came across a very interesting organisation that is fully dedicated to all things that have to do with Astronomy.

The name of the organisation is: The Cape Astronomical Association. It was formed in 1912 and was the first astronomical society in South Africa.

This group is mainly composed of amateur astronomers, professional scientists and the members come from different backgrounds and are different ages. Their levels of knowledge and experience range from those who are beginners to the more experienced experts. They actively pursue all things to do with Astronomy.

It is fascinating to know that there are people out there who are interested in Astronomy so much that they are willing to dedicate a lot of time and effort into it. I hope you enjoy reading our Astronomy edition and get inspired to join any Astronomy group or even any science group you really find interesting. It will not only improve your knowledge about that specific science but also ensure you pass your area well to prepare you for your tertiary education.

Enjoy and be inspired! It all begins with you!

Evans Nyasha Manyonga
Managing Editor

Science Stars

team

Managing Editor • Evans Manyonga

editorial@sciencestars.co.za

Graphic Designer • Cinzia-Joey Swartz

Project Manager • Renata Williams

Contributing Writers • Unathi Kondile
• Donovan Goliath

Chairman • Madambi Rambuda

Sales Executive • Tinyiko Khoza
tk@sciencestars.co.za

Ambassador • Azwindinni Muronga

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media **m**

31 Brickfield Road,
Upper East Side, Unit 9B
Cape Town

021 447 7197
info@sciencestars.com
www.sciencestars.co.za



Up there, looking down

The South African National Space Agency is harnessing space science and technology to **benefit society** and the planet. Whether through earth observations, space operations, space science or space engineering, there are **boundless opportunities** when you consider a **career in space**.



Down here, looking up

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In Service of Humanity

THE SKY IS NOT THE LIMIT, THE UNIVERSE IS

We are all made of star stuff!

“I wish you’d taught me science when I was in High School! Maybe I would have enjoyed it!” These were my parting words as I walked out of Dr Tana Joseph’s office in the Astronomy department at the University of Cape Town.

Tana holds a BSc (Hons) in Physics and MSc in Astrophysics and Space Science from UCT; where she is currently a Postdoctoral Research Fellow working on multi-wavelength studies of high energy binary systems.

Just saying what she does is enough to scare any young person away from Astronomy but the way she explained it made it easier to see.

“So, Multi-wavelength means looking at stuff with different types of light; not just optical light but radio, gamma, x-rays and there are all these different types of telescopes that can detect each type of light,” she explains.



Dr. Tana Joseph

It all began with the Hubble Space Telescope. In 1994, at the age of 10, Tana kept seeing beautiful pictures of space taken with the Hubble Telescope in the newspapers.

“My dad used to buy the Cape Times [newspaper] and I would cut out the pictures and put them in my scrap book!” she enthuses.

“I wanted to be an astronaut; but back then you could only become an astronaut if you were American or Russian. So the Hubble pictures made me realise that I still loved space and I could actually do astronomy.”

One thing that really made her follow her dream was the fact that her parents were very supportive. It makes sense though, because both her parents were science

teachers in Cape Town's Bonteheuwel township. Her dad has since retired but her mother still teaches biology (life sciences) to this day.

Unfortunately, in 2003 when she entered university, Astronomy was no longer being offered to undergraduates so she had to do a BSc in Physics first. Only in her postgraduate studies did she get into Astrophysics and Space Science.

Astronomy still faces a challenge in the sense that there are not many young peo-



ple saying, "I want to become an astronomer when I grow up," and this is largely because they do not see any job prospects in it. There also hasn't been much awareness around Astronomy opportunities but with the popularity of the Southern African Large Telescope (SALT), the Square Kilometre Array (SKA) and Meerkat, Astronomy is fast being put on the map of interest.

Science in general is about learning about the world around us, but people can't see how astronomy helps. So, we asked Tana what the exact benefits of being an astronomer are?

"Yes, it seems like there is no obvious return and people want to know what they will get from Astronomy - what do Astronomers produce? For me personally, the more you know about the universe the more you feel connected to where you are and connected to each other. Carl Sagan once said 'we are all made of star stuff!'"

Tana is also aware of the fact that some South Africans do not go into jobs because they love them or seek to be connected to other humans; "we mostly get jobs because we want to make money".

Did you know ?

- That Galileo Galilei was one of the first people to make a telescope (1609). He was the first to see Jupiter's four biggest moons and the rings of Saturn.
- That Karl Jansky became the first to detect radio emission from an astronomical source (1931)? He had picked up radio waves coming from the central region of our Galaxy.
- That the first black astronomer in South Africa was Dr Thebe Medupe who grew up in a poor village outside Mmabatho.

"Your family is investing in your university education and they do so with the knowledge that they will reap the rewards when you graduate. So, in terms of opportunities Astronomy is a hugely growing area in the world. The Department of Science and Technology (DST) has been fantastic, they are really trying to move to a knowledge-based economy. The government is funding the National Astrophysics and Space Science Programme (NASSP), funding SKA,



Dr Tana Joseph's role models are actually not all astronomers, they are mostly very powerful politicians like:

.....
Hillary Clinton, Condoleezza Rice and Angela Merkel (president of Germany who has a science PhD).

funding human capital development and are also trying to fund many science teachers."

Apart from working in the science faculty people with Astronomy qualifications can also work in other industries, because they have what is called transferable skills. Being trained in science means you have a strong background in maths, problem solving and computing. So that means you can go work anywhere in the world.

"There's this buzz word called 'Data

Science' - people who work in Astronomy and other hard sciences are used to working with data, used to writing computer programmes, used to analysing data to get useful information out of it and that is becoming more and more in demand. So you should not feel as if you did a BSc or Masters in Astronomy you will struggle to find a job. Your skills are in demand," adds Tana.

One of the greatest things about Astronomy is that you can go outside at night and just stare at the sky. You might have questions about stars and colours in the sky. And just like that, you have begun Astronomy. Go out there! Do it! The sky is not the limit – there's still the whole universe waiting to be probed.

Task:

What is the difference between these different wavelengths that Tana works with?

Radio
 Microwave
 Infrared
 Ultraviolet
 X-Ray
 Gamma Ray

FROM CLASSROOM TO BOARDROOM

A DECADE OF EMPOWERMENT



From building schools to supporting black entrepreneurs, from making university study possible for disadvantaged students to providing work experience for young work seekers, Shanduka Foundation strives to develop South Africa's human potential. Over the last decade, Shanduka Foundation has created opportunities for educational development, career growth and entrepreneurial advancement.

- **Adopt-a-School Foundation** mobilises companies and individuals to adopt disadvantaged schools with the aim of improving the academic, infrastructural, social and security environment in schools.
- **Shanduka Black Umbrellas** nurtures qualifying 100% black-owned businesses by providing meaningful access to markets, networks and finance through its small enterprise incubators and online enterprise and supplier development portal.
- The **Cyril Ramaphosa Education Trust** provides bursaries to disadvantaged students and organises vacation work in companies in the Shanduka Group.
- The **Shanduka internship programme** provides experiential training for selected learners and job seekers within Shanduka Group and across its partner network.

Thanks to the ongoing support of many partners in business, government and civil society, Shanduka Foundation is making a significant impact in the lives of young South Africans.

To find out more about the work of the foundation and its programmes, visit
www.shanduka.co.za/shanduka-foundation

 **SHANDUKA**
Foundation

CELEBRATING HUMAN CULTURE

Eastern Cape Community Centre artists to join SKA delegation in Australia



As part of a collaboration between science and indigenous art, three artists from a small community art centre in Nieu-Bethesda in the Eastern Cape have travelled with an engineering delegation from SKA South Africa to Australia for the launch in Perth on 30 September 2014 of the Shared Sky project. This art exhibition will run in parallel with the SKA Engineering meeting in Perth, which brings together the teams from around the world who are working on the design of the first phase of the Square Kilometre Array telescope, to be built from 2018 in South Africa and Australia.

Shared Sky stems from a vision by the Square Kilometre Array Organisation (SKAO) to bring together South African and Australian artists in a collaborative exhibition celebrating humanity's ancient

cultural wisdom and explanations of the Universe. The exhibition draws on the art and history of the people whose ancestors stood on the same soil where the SKA telescopes will stand, and looked up at the same, Shared Sky of the Southern Hemisphere.

Nieu-Bethesda Community Arts Centre Director Jeni Couzyn, and artists Sandra Sweers and Gerald Mei - whose /Xam ancestors lived where the SKA South Africa telescopes are being built - have created a display of quilts that capture elements of /Xam mythology around the origins and movements of celestial bodies, such as the Sun, the Moon and the Milky Way, and even of a mythological character with links to dark matter (which holds the galaxies together and which allows the first stars and galaxies to form in the

Universe).

They will meet fellow artists from the Yamaji Centre and other Aboriginal people who, until the mid-19th century, were still living a largely traditional way of life, hunting and gathering on the land that is now the site of the Australian SKA. They will examine shared themes around their understanding of the night sky that their artwork has captured.

Understanding what sustains the rhythms and patterns of the world around us continues to be one of humankind's most enduring fascinations.

The movement of objects across the night sky has been a profound source of inspiration for artists since time immemorial.



According to SKA South Africa Director Bernie Fanaroff, science and art have a lot in common: "They are both about beauty and aesthetics -most science is beautiful, and so is most art. The quilts are really beautiful in themselves - colourful and dynamic; science is like that too." Being located on similar latitudes on both continents, the two sites in South Africa and Australia present essentially identical views of the night sky to the people who have lived there for tens of thousands of years, and to whom some of the oldest known artwork on earth can be attributed.

The official launch of the Shared Sky exhibition will be at the John Curtin Gallery in Perth on 30 September 2014, where it will remain until 2 November. It is scheduled to arrive in South Africa early in 2015.



MeerKAT ANTENNA

TOTAL HEIGHT: 19.5 m; TOTAL STRUCTURE WEIGHT: 42 TONS

The antenna consists of the main reflector (effective diameter 13.5 m) plus the sub-reflector (diameter 3.8 m). The main reflector is made up of 40 panels, made of aluminium. The sub-reflector is a single composite structure.

Lightning conductors around the reflectors protect the structure during lightning strikes.

The L-Band receiver and the UHF-Band receiver are mounted on the receiver indexer. The indexer can accommodate up to four receivers.

Steel support framework and connecting back-up structure.

The yoke, elevation bearing and drive motors allow the reflectors to tilt up and down.

The receiver indexer can rotate each receiver to the desired focal position.

The azimuth bearing and azimuth drive motors allow the structure to rotate in a horizontal plane.

The L-Band digitiser and the UHF-Band digitiser are mounted on the indexer.

The pedestal contains the drive control system.

An underground network of fibre optic cables links each receptor to the Karoo Array Processor Building (KAPB) on site.

The pedestal is anchored and bolted to a concrete foundation.

UK-SOUTH AFRICA NEWTON FUND

A science and innovation partnership

The United Kingdom and South Africa are determined to take their already strong science and innovation relationship to the next level and have therefore agreed to launch a fund embodying this partnership based on the principles of co-ownership and co-responsibility. The UK-South Africa Newton Fund will bring together contributions from both sides to support science, technology and innovation, creating a catalyst to stimulate socio-economic development in South Africa and more widely across sub-Saharan Africa. Both countries will also be looking actively to work closely with other African countries in this initiative.

The UK and South Africa have jointly committed up to R140m per year under the Newton Fund, including funding from non-governmental bodies and the private sector, such as GlaxoSmithKline.

The Fund will support projects in the thematic areas of public health, environment and food security, and science and technology capacity building, with a focus



on seeking to ensure that activities have a regional footprint, with the ultimate aim of encouraging research that boosts jobs and growth. There will also be a special focus on "big data".

The UK Minister for Africa, James Duddridge, and South Africa's Minister of Science and Technology, Naledi Pandor, signed a memorandum of understanding for the first three years of the programme

to this effect in Cape Town on 9 September.

Speaking at the launch, Minister Pandor welcomed the cooperation, saying the two countries enjoyed strong bilateral relations in numerous areas of mutual interest, including various engagements that emphasised societal development.

The medical research councils of both countries also announced three-year



Mr James Duddridge and Ms Grace Nadeli Mandisa Pandor

partnerships to collaborate on research projects in the areas of tuberculosis and non-communicable diseases, which will likely see wider non-government participation too.

UK Royal Academies, together with the

National Research Foundation, announced a scheme for 90 Fellowships and 150 mobility grants.

The South African-United Kingdom Bilateral Forum, which is the high-

level mechanism through which relations between the two countries are conducted, was established in 1997. It will next meet in September 2015, where science and technology will be important themes.

South Africa and the UK signed a bilateral agreement on science and technology cooperation in February 1995, focusing on areas such as climate change, biotechnology, astronomy and global change.

Like South Africa, the United Kingdom aims to build on its world-class research, increase business investment in research and development spending, ensure a strong supply of scientists, engineers and technologists, and raise public interest and awareness of scientific research and innovative applications.



CELEBRATING WORLD SPACE WEEK 2014

Guiding Your Way

How often do you wonder about what lies beyond the wide expanse of the sky you see every day?

Apart from an occasional glance at the heavens to check the weather, do you ever think about how your life is influenced by space? People tend to associate space with telescopes and astronauts travelling to the moon, not realising how critical the boundless space beyond the Earth's atmosphere has become in our daily lives.

South Africa's HartRAO site in

Hartebeesthoek hosts several radio telescopes, which are used as GPS receivers, among other things.

Whenever you pick up your cellphone to call a friend, use the Internet to google, email a colleague who may be in an office on the other side of the world, or switch on to watch your favourite DStv show, you are accessing a resource through space technology. Everyday space technology uses satellites that send and receive information to and from Earth. For instance, satellites in space get information about weather systems to improve the accuracy of the weather forecasts, so you can prepare for rain or a hot summer's day. Satellites and their supporting applications help you navigate by sending information to your car's GPS (Global Positioning System). Such information

is also used to identify and locate aeroplanes and ships, as well as monitoring movement across a country's borders.

Apart from the convenience it adds to our lives, space technology has helped us get a better understanding of our planet through Earth observation. Several satellites have been developed and placed in space to collect information and images of the Earth's surface, including land and water masses, urban areas and forests.

Images enable us to observe land being used for farming or industrial purposes, protect our indigenous ecosystems, plan and monitor the expansion of towns and cities, and check on the water levels in our rivers and dams.

South Africa is committed to developing an advanced space industry over the next few decades. National challenges such as job creation, poverty and resource management will be addressed through the capability of space technology.

As South Africa celebrates World Space Week, the Department of Science and Technology hopes young people will participate in space science-related activities organised through the South African Agency for Science and Technology

Advancement (SAASTA). The focus will be on exposing the general public, pupils and teachers to space science through workshops, role models, exhibitions, demonstrations and various hands-on activities.

World Space Week 2014 will kick off with the launch of two weather balloons into near space on 4 October, simulating the launch of a satellite into space. The balloons will lift off from Vryburg in the North West, with the aim of illustrating the benefits of project-based, science learning activities. The launch is a collaboration between the South African National Space Agency (SANSA), the Secunda Amateur Radio Club, and 80 of Mpumalanga's top achieving learners.

On 6 October, Dr Michael Kosch of SANSA, will deliver a public lecture in Hermanus, in the Western Cape, on "Sprites in Space". Sprites are electrical discharges that take place during thunderstorms, producing amazing visual atmospheric phenomena.

World Space Week activities will take place throughout the country, with a particular focus on the Eastern Cape, where Minister Pandor will speak at an open day at Walter Sisulu University in Mthatha. The open day will be preceded by roadshows in and around Mthatha.



GALLERY



PICK THE SECTION THAT DESCRIBES YOU BEST AND FIND YOUR STUDY STYLE






Section 1



Are you a Visual Learner?

- *Good at spelling but forget names
- *Need quiet study time
- *Have to think a while before understanding a lecture
- *Like colours & fashion
- *Dream in colour
- *Like charts

This means your brain is more likely to understand and remember things that you see. You can use this to your advantage when studying by following these simple tips:

-  Sit near the front of the classroom and look at your teacher (It won't mean you're the teacher's pet!)
-  Try drawing mindmaps to visually plot out how the facts are connected.
-  When summarizing, draw pictures of key words in your notes – have some fun with it!
-  Highlight and underline – use a lot of bright colours – it's as exciting to your brain as pictures.
-  Use flash cards with pictures & symbols to help you remember the facts.
-  If you can find a video about the work you are studying – watch it!






Section 2



Are you an Auditory Learner?

- *Like to read to yourself out loud
- *Are not afraid to speak in class
- *Remember names
- *Notice sound effects in movies
- *Enjoy music
- *Read slowly

This means your brain is more likely to process and store things by the way they sound. Here are some simple tips to help you make the most of this ability while studying:

-  Remember that you need to hear things, not just see things, in order to learn well. Study new material by reading it out loud.
-  Join a study group so you'll be able to hear yourself and others explain the work.
-  Use word association to remember facts and lines or make up little catchy songs about the work.
-  Record your notes so you can listen to them later when you review the work (try using your phone).
-  Repeat facts or listen to your recorded notes with your eyes closed – taking away one sense, heightens another.






Section 3



Are you a Tactile Learner?

- *Good at sports
- *Can't sit still for long
- *Do not have great handwriting
- *Like the science lab
- *Study with loud music on
- *Like adventure books & action movies

This means you're more likely to grasp and memorise things when physical movement is involved. Use these tips to help find a more "hands on" approach to your work:

-  It's OK to chew gum, walk around, or rock in a chair while reading or studying – movement or touching something will soothe your brain while learning.
-  Try role playing with a friend to demonstrate what you guys are learning – acting things out will make you remember them clearer.
-  Take frequent breaks during reading or studying periods (frequent, but not long). This will help you stay focused when taking in work.
-  Try interacting with the work as much as you can – for instance, if you're learning about a leaf then go outside and fetch a leaf to inspect.
-  Type out your written notes on a computer, touching the keys will stimulate you while also reviewing the work.

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ESKOM EXPO



ESKOM EXPO HIGHLIGHTS

The Eskom Expo for Young Scientists is South Africa's most prestigious and only existing international science fair that provides learners with the opportunity to enter a project to exhibit their own scientific investigation. The project aims to inspire and develop young scientists who are able to identify a problem, analyse information, find solutions and communicate findings effectively.





FALLING WALLS – BUILDING BRIDGES

Generation Y

Vinu Nair is on his way to represent young South African innovators at the Finale in Berlin on 8 November, following his winning presentation at the Falling Walls Lab held at the the Sci-Bono Discovery Centre in Johannesburg.

With an impressive and ambitious plan to mobilize young people into engineering through his flagship campaign Generation Y, Nair won the hearts of the jury because of the potential feasibility and relevance of his idea in Africa.

The highlight besides Nair's win was the vibrancy of presenters. It was a tapestry of ideas that seek to change the world, rooted on ingenuity and some, on grass-roots solutions for local problems. From a drive to generate clean water through laboratory tests to working with recycling merchants known as 'Abomakgereza' in

Johannesburg, the jury had a tough calling to choose the winner.

Wim Plaizier, Managing Partner and Head of Africa at A.T. Kearney in Johannesburg and Chairman of the jury panel at the Lab summed up the sentiments: "This year the FallingWalls Lab showed again that Africa is a continent of hope. The participants represent a generation of tremendous opportunity and they should be encouraged to deliver on that."

The Falling Walls Lab is an annual event that provides a platform for young researchers, academics, entrepreneurs and professionals to share their breakthrough ideas, research and prototypes. The event is themed around the fall of Berlin walls, the then symbol of division in Europe. The German Ambassador to South Africa, Dr. Horst Freitag said, just like the Berlin Wall,

the current social problem facing the world are meant to be conquered.

Some borders are meant to be transcended and pushed

In three-minute speeches at the Lab, the 22 shortlisted entrants tried to convince a high profile jury of the urgency, power and feasibility of their breakthrough. The top three presenters shared their breakthrough ideas on unlocking the potential of Generation Y engineers, an empowering community-based water quality monitoring tool that anyone can use and the first completely natural substrate that allows for sustainable mushroom farming.

Previous winners of the South African Falling Walls Lab include John Woodland, a PhD student at the University of Cape Town. John went on to win third place at the 2013 Finale in Berlin with his concept of a fluorescent probe to accelerate the detection of malaria.

The jury also included the German Ambassador to South Africa, Dr. Horst Freitag, Dr. Thomas auf der Heyde, Deputy Director General at the Ministry of Science and Technology, Professor Adam Habib, Vice Chancellor of Wits University, Liesel De Villiers, Head of Research and Development at African Explosives Limited and former Minister Roelf Meyer.



SCIENCE NEWS



On the 6th of October astronauts embark on a 6-hour first spacewalk outside the International Space Station to perform maintenance work including putting an old cooling pump into storage.

Isamu Akasaki, Hiroshi Amano and Shuji Nakamura won the 2014 Nobel Prize in Physics for inventing blue-light emitting diodes (LED).

On the 30th of September Minister Pandor appointed new NACI Council members.

Did you know that the sound you hear when you crack your knuckles is actually the sound of oxygen, carbon dioxide and nitrogen gas bubbles bursting.

SANRAL and the University of the Free State have jointly launched a New Chair in science, mathematics and technology education. SANRAL will provide the New chair with R30 million.

Prof Loyisa Jitawas appointed as the first UFS SANRAL Chair.

**There are boundless opportunities
when you consider a career in space.**

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POSSIBLE CAREERS:

SATELLITE OPERATIONS TECHNICIAN



REMOTE SENSING RESEARCHER



RADIO FREQUENCY ENGINEER



SPACE WEATHER FORECASTER



Space in our everyday lives



We use communication satellites every day when we watch Digital Satellite television (DStv), access the internet or use our cell phones.



Navigation apps use GPS satellites to accurately steer you to your requested destination.



Spacecraft are launched into space on rockets and need to be monitored along the way. SANSa provides launch support and recently assisted two Mars launches – NASA's Mars Science Laboratory and India's Mars Orbiter Mission.



Weather in space can damage satellites and interfere with our technology like GPS, cell phones and internet. SANSa keeps a close eye on space weather to protect our technology in space and on Earth.



Images from satellites are used to develop maps and monitor natural disasters like floods and droughts.



South African National Space Agency

Tel +27 12 844 0398 | Fax +27 12 844 0396

Email information@sansa.org.za | Website www.sansa.org.za



The ten teams competing in this year's Sasol Solar Challenge faced their first hurdle when scientists at the Council for Scientific and Industrial Research (CSIR) scrutinised vehicles in order to get the go-ahead for participation in this year's race.

Scrutineers spent two days at the Zwartkop Raceway in Centurion to ensure that these solar-powered vehicles not only meet the Fédération Internationale de l'Automobile (FIA) regulations, but that they are also safe and stable enough to compete on public roads in this epic challenge. The challenge will start in Pretoria on 27 September and end some 2 000 km later in Cape Town, on 4 October.

The route has pit-stops in Sasolburg, Kroonstad, Bloemfontein, Colesberg, Graaff-Reinet, Port Elizabeth, Knysna and Swellendam and cars will cover around

260 km a day, powered only by sunlight.

As a key partner to the Sasol Solar Challenge and staunch supporter of solar research, the CSIR contributes towards the solar challenge by making its technical and scientific staff available to help to handle the vehicle assessment process.

Scrutineer, Tumelo Motloutsi, a CSIR software engineer studied the FIA regulations – the governing body for world motorsport – which stipulates the rules for the four different classes of cars taking part.

"Cars must comply not only with the FIA regulations, but must also be roadworthy as the race takes place on public roads," he explained.

He added that there are two main criteria – the physical and mechanical aspects, and the electrical system. The latter

includes producing a battery electromotive force certificate and ensuring that the car's electrical systems are safe not only for the driver, but also for other road users and spectators.

Commenting on other safety considerations, Motloutsi said, "Batteries must be properly located and not in close proximity to the driver while a safety cut-out switch must be provided to render the car safe in the event of an accident. From a physical and mechanical perspective, cars must be inherently stable, be able to perform manoeuvres in line with their size and speed capability, not cause a hazard to other road users and provide protection for the driver."

A full-scale braking test was also conducted to ensure that cars stop properly. Any aspects of the car that do not meet the regulations had to be corrected by the teams prior to race day.



Competing against teams from the Netherlands, Turkey and Cyprus are local teams from the University of KwaZulu-Natal, North-West University, Tshwane University of Technology, the University of the Witwatersrand, the University of Johannesburg, and the University of Cape Town. This year, the challenge will also include participation from Maragon Private School.

Sasol became involved with its first solar challenge in 2012. "As a business, we believe that it is vitally important to be part of an event which promotes research into the development of innovative technology," said Richard Hughes, Sasol Group Sponsorship Manager.

"Of equal or greater importance is that

the event presents an ideal platform for the promotion of STEM subjects – Science, Technology, Engineering, and Mathematics among young learners and future leaders," he continued.

It is this motivation that aligns with Sasol's ongoing initiatives and long-term goal to encourage the youth to embrace technical subjects. By using the event to spark the interest of young people and particularly learners in these key educational subjects, the company believes it will help address the critical technical skills shortage at grassroots level.

"Many tertiary institutions are including the construction of solar-powered cars in their curriculum for degree courses. This is

because the benefits to students who build these cars push the knowledge envelope," explained Hughes.

"Students are exposed to the whole gambit of organisation that goes on behind the scenes of the race – from planning, budgeting, logistics, materials procurement, construction techniques, harnessing appropriate technologies or developing new ones and ensuring that all these elements come together to provide a winning combination," he concluded.

Learners, students and the general public are encouraged to follow the journey, support the teams, meet the drivers and witness solar-vehicle technology and innovation in motion.



GALLERY



ASTRO QUIZ

What is the AstroQuiz? AstroQuiz is a competition aimed at Grade 7 learners based on themes around astronomy.

The project is funded, coordinated and managed by SAASTA. Project resources for the participants are gathered and produced with the assistance of the participating centres as well as astronomy community members.

SAASTA invites selected centres to participate in the project. Each participating centre is responsible for implementing the project up to the finals, and to liaise with their local Department of Education and schools.

Project background

In October 2005, the Sci-Bono Discovery Centre received a grant from SAASTA to plan, implement and manage an astronomy quiz for Gauteng primary schools as part of the national Astronomy Platform Month.

The event was held in the form of a knock-out quiz for teams of Grade 7 learners, with winners in each stage progressing on to the next round. The project, with 23 schools participating, was a resounding success, drawing much attention in the community.

A primary school Astronomy resource pack was produced and made available for dis-

tribution to participating schools as part of preparation for the competition.

Project objectives

The proposed project aims to improve teaching and learning of basic astronomy in primary schools.

The objectives of the project are the following:

- To contribute to the improvement of awareness, interest, understanding and insight into basic astronomy;
- To build appreciation of and pride in South Africa's history of astronomical activity and achievements, and current projects.

Project structure

The Participating Schools

Each participating centre works with their local education department office to identify and select participating schools. A recommended number of 30 schools per centre was set for the first project, but centres are encouraged to involve greater participation with the assistance of their departments of education. Each school fields one team of four Grade 7 learners.

The Quiz

The quiz is run as a knock-out event. Teams of four grade 7 learners per schools enter, with each participating school being allowed to field one team.

ASTRO QUIZ ? ROUND 3

1 The reason why we have day and night on Earth is due to the _____

1. Revolution of the Earth
2. Rotation of the Earth
3. Tilting of the Earth
4. Gravity between Earth and the Sun

2 Who was the first astronaut to perform a spacewalk in March 1965?

1. Alexei Leonov
2. Alan Shepard
3. Valentina Tereshkova
4. Yuri Gagarin

3 Yuri Gagarin, the first man in space orbited the Earth once in 1961. Two years later, the first woman in space orbited our planet ...

1. 3 times
2. 37 times
3. 48 times
4. 118 times

4 A combination of the following factors causes the Moon to appear the same size in the sky as the Sun.

1. Its size and distance from the Earth
2. Its size and colour from the Earth
3. Its movements around the Earth and the Sun
4. Its appearance and shape

5 An astronomical event that occurs twice each year as the Sun reaches its highest or lowest excursion relative to the celestial equator on the celestial sphere is called a/ an _____

1. Solstice
2. Equinox
3. Ecliptic
4. Easter

6 If your weight on Earth is 50 kg, what would your approximate weight be on the Sun and on the Moon?

1. 119 kg (Sun) and 115 kg (Moon)
2. 873 kg (Sun) and 39 kg (Moon)
3. 1000 kg (Sun) and 960 kg (Moon)
4. 1353 kg (Sun) and 8 kg (Moon)

7 What is the popular name for the robot geologist that NASA use for exploration on Mars?

1. Scopes
2. Capsules
3. Orbiters
4. Rovers

8 Which of the following will you NOT find in our Solar System?

1. Meteor stream
2. White Dwarf
3. Comet
4. Asteroid

9 Which of the following statements is true about a comet's tail?

1. Always point towards the Sun
2. Is sometimes absorbed by the comet
3. Always trails behind the comet
4. We cannot tell which way the tail points when it is on the other side of the Sun

10 Why the Moon is not considered a planet? It is because

1. It is too small
2. It is too large
3. It orbits the Earth
4. It is too close to the Earth

11 If your age on Earth is 14 years, how old will you be on planet Venus?

1. Same age as on Earth
2. 14 Venusian years
3. More than 14 Venusian years
4. Less than 14 Venusian years

12 How was Pluto discovered?

1. By Apollo 8 astronauts during their lunar mission
2. By two amateur German astronomers who accidentally came across it in 1908 while studying the night sky
3. By Clyde Tombaugh photographing the same _____ region of the sky on two successive nights in 1930, seeing shifts in a point of light
4. By Arthur Eddington who discovered it with the aid of mathematics when he realised that Neptune was slightly pulled off its normal orbit

ASTRO QUIZ ? ROUND 4

1 Who discovered that each black hole has a characteristic temperature and radiates energy?

1. Robert Oppenheimer
2. Stephen Hawking
3. John Herschel
4. Albert Einstein

2 The Square Kilometre Array is a _____ telescope.

1. Radio
2. Refractor
3. Reflector
4. Dobsonian

3 Which woman astronomer discovered that variable stars known as Cepheids could be used as distance markers?

1. Henrietta Swan Leavitt
2. Cecilia Payne Gaposchkin
3. Annie Jump Cannon
4. Carolyn Shoemaker

4 Which planet was accidentally discovered in 1930?

1. Pluto
2. Saturn
3. Mars
4. Uranus

5 What is the name of the US spacecraft that arrived at Venus and stayed there for a year in 1990?

1. Viking 2
2. Surveyor
3. Mariner 2
4. Magellan

6 If the Moon revolves the Earth at a speed of 1,02 km/h, approximately how long will it take to go completely around the Earth?

1. 27, 3 days
2. 40 days
3. 27,3 years
4. 40 years

7 What are quasars?

1. Faint stars
2. Unusual galaxies
3. Nebulae
4. Binary stars

8 A combination of the following factors causes the Moon to appear the same size in the sky as the Sun.

1. Its size and distance from the Earth
2. Its size and colour from the Earth
3. Its movements around the Earth and the Sun
4. Its appearance and shape

9 During a total solar eclipse the Moon's shadow causes a narrow path of total darkness across the Earth. What is this path of total shadow called?

1. Umbra
2. Penumbra
3. Corona
4. Luna

10 What do scientists think will be found in the centre of the Milky Way?

1. The Sun
2. A supermassive black hole
3. An asteroid belt
4. A star

11 Name the astronomer who discovered pulsars in 1967.

1. David Gill
2. Henrietta Swan Leavitt
3. Edwin Hubble
4. Jocelyn Bell-Burnell

12 The spacecraft Dawn is on its way to investigate two Solar System objects. Which objects are these?

1. Pluto and Charon
2. Ceres and Vesta
3. Mars and Jupiter
4. Saturn and Neptune

13 Jupiter has a moon that is larger than planet Mercury. What is it called?

1. Callisto
2. Deimos
3. Europa
4. Ganymede





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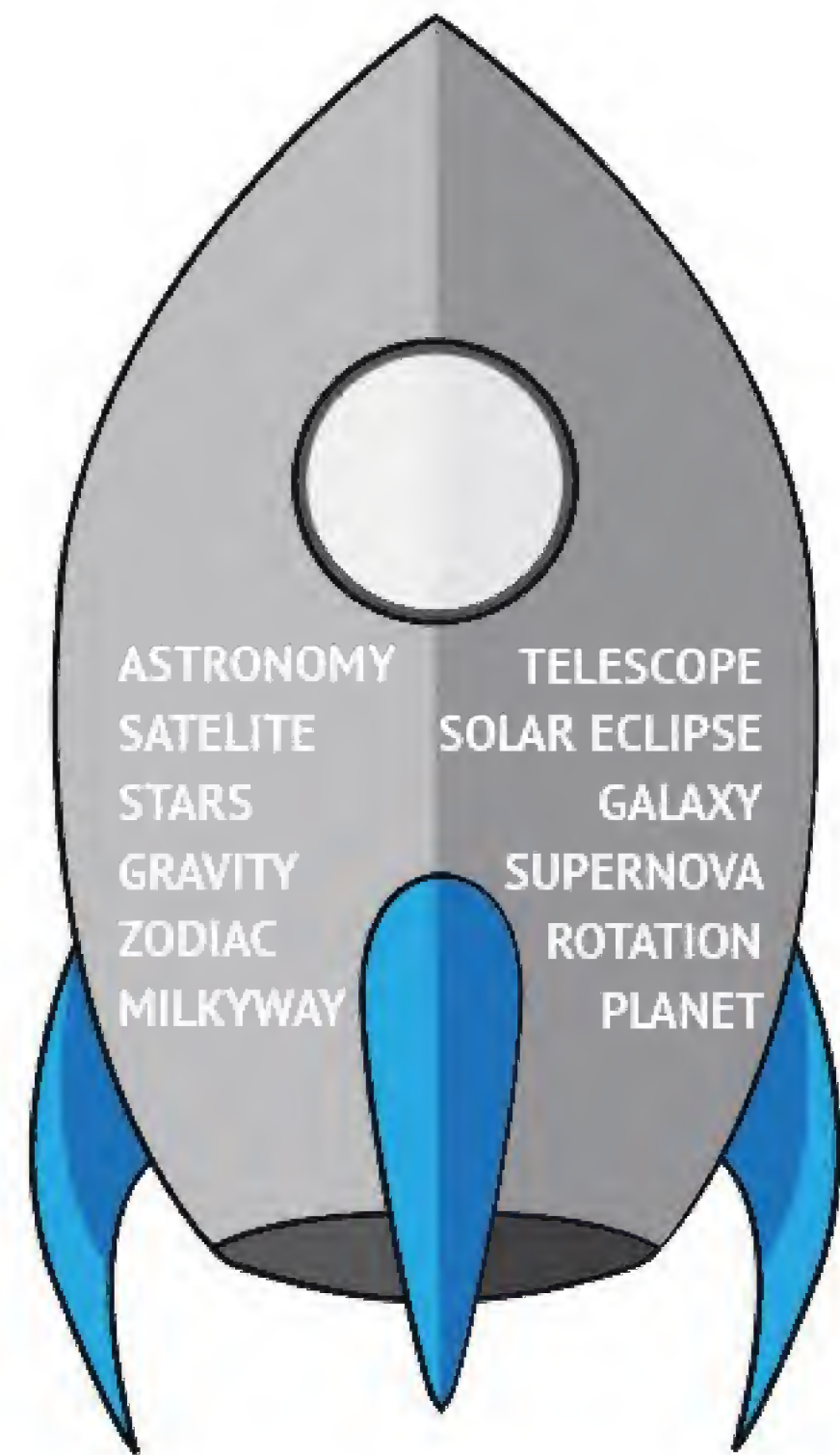
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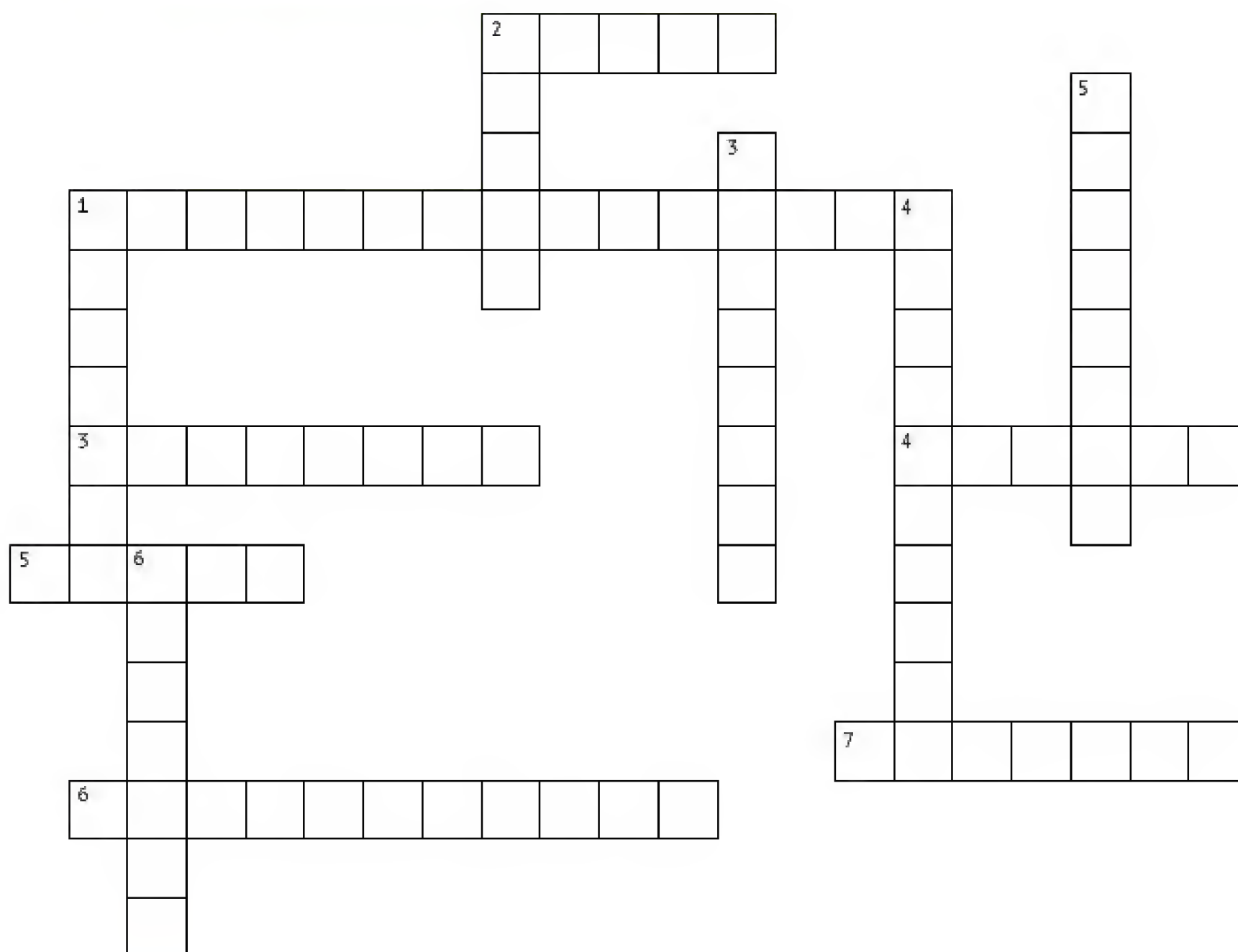
WORD SEARCH

Find the listed words in the puzzle block, draw a ring around each word.

A	V	O	N	R	E	P	U	S	I	T	E
A	C	G	S	B	U	E	Z	I	E	S	T
D	A	A	R	I	T	T	E	L	P	E	I
Y	I	L	I	O	S	L	E	I	L	N	L
A	D	A	L	P	I	S	L	M	A	O	E
W	O	X	M	L	C	C	X	I	N	I	T
Y	Z	Y	L	O	E	A	I	L	E	T	A
K	M	I	P	R	K	P	N	P	T	A	S
L	O	E	A	T	S	T	A	R	S	T	I
I	N	L	N	O	E	S	I	S	E	O	N
M	O	K	G	R	A	V	I	T	Y	R	S
S	M	Y	M	O	N	O	R	T	S	A	T



CROSSWORD PUZZLE



DOWN

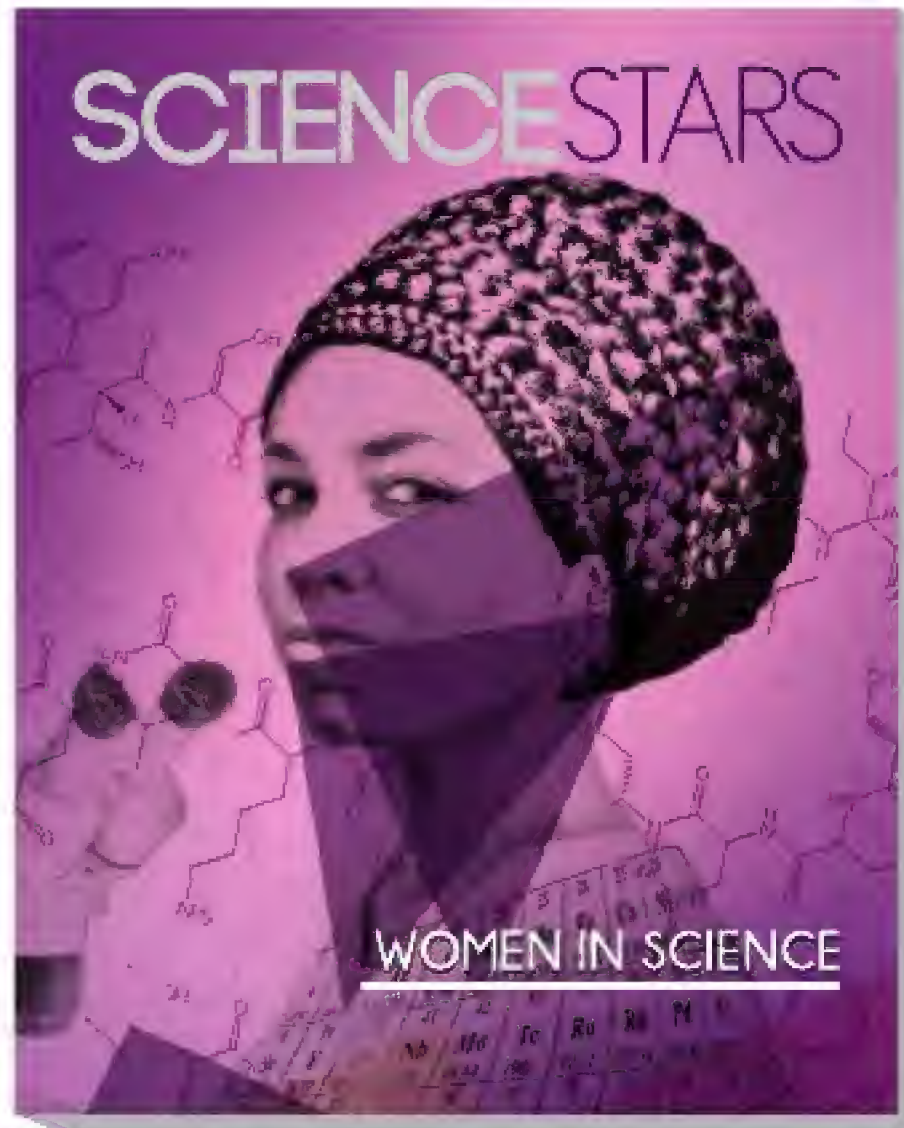
1. What is the largest terrestrial wild animal?
2. What colour of heat radiation represents the highest temperature?
3. What plant is not capable of manufacturing its own food?
4. What parts of the sun is easily visible only during a total solar eclipse?
5. Most commercial nuclear power plants worldwide are cooled by?
6. When a gas is turned into a liquid, the process is called?
7. A device used to measure the amount of moisture in the atmosphere is called a?

ACROSS

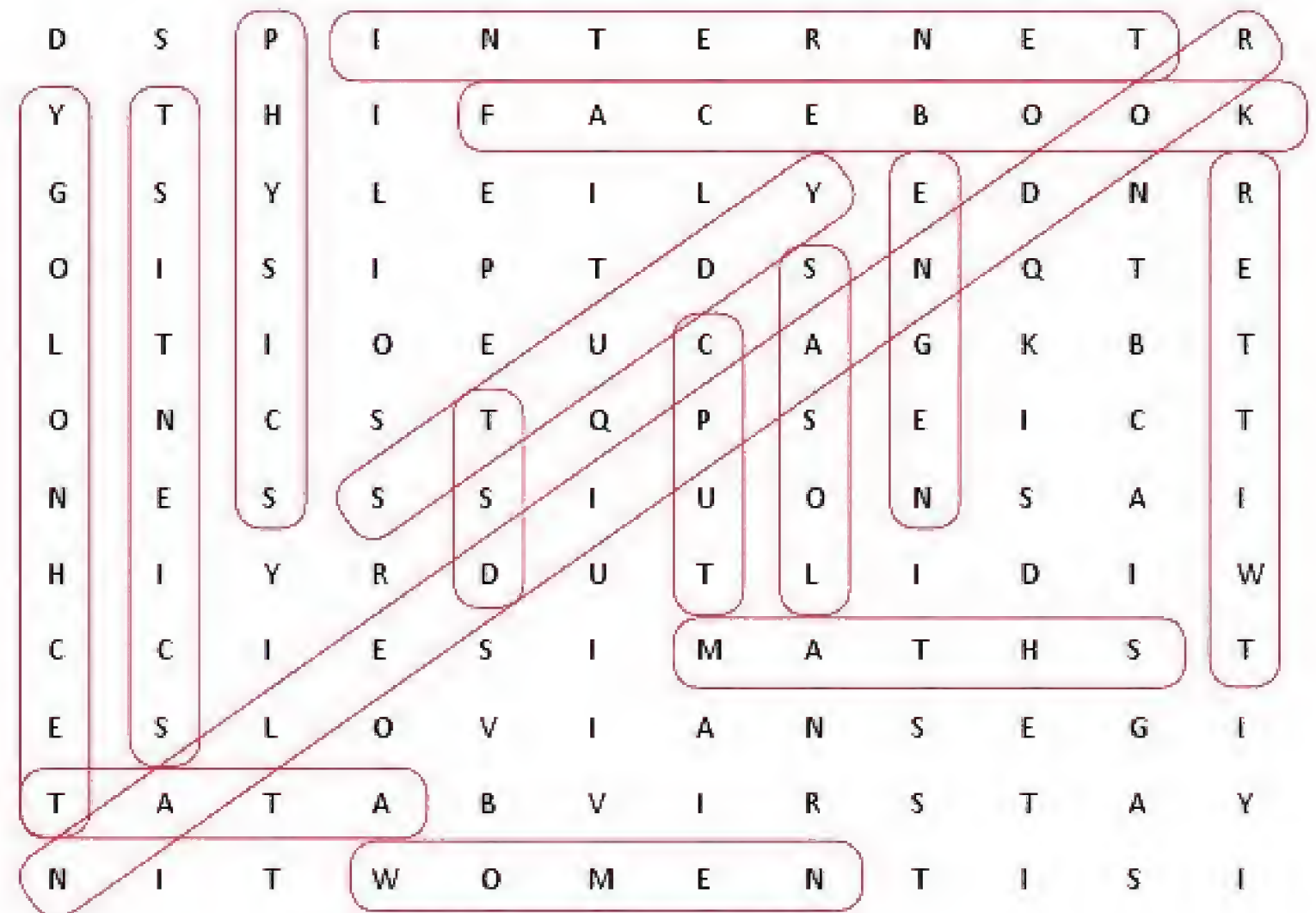
1. Deficiency of iron leads to?
2. Earth quake waves travel faster in?
3. What is an important element of stainless steel?
4. The study of poison is called?
5. The most abundant organic molecule on the surface of the earth is?
6. Plants get their nitrogen from?

ANSWERS

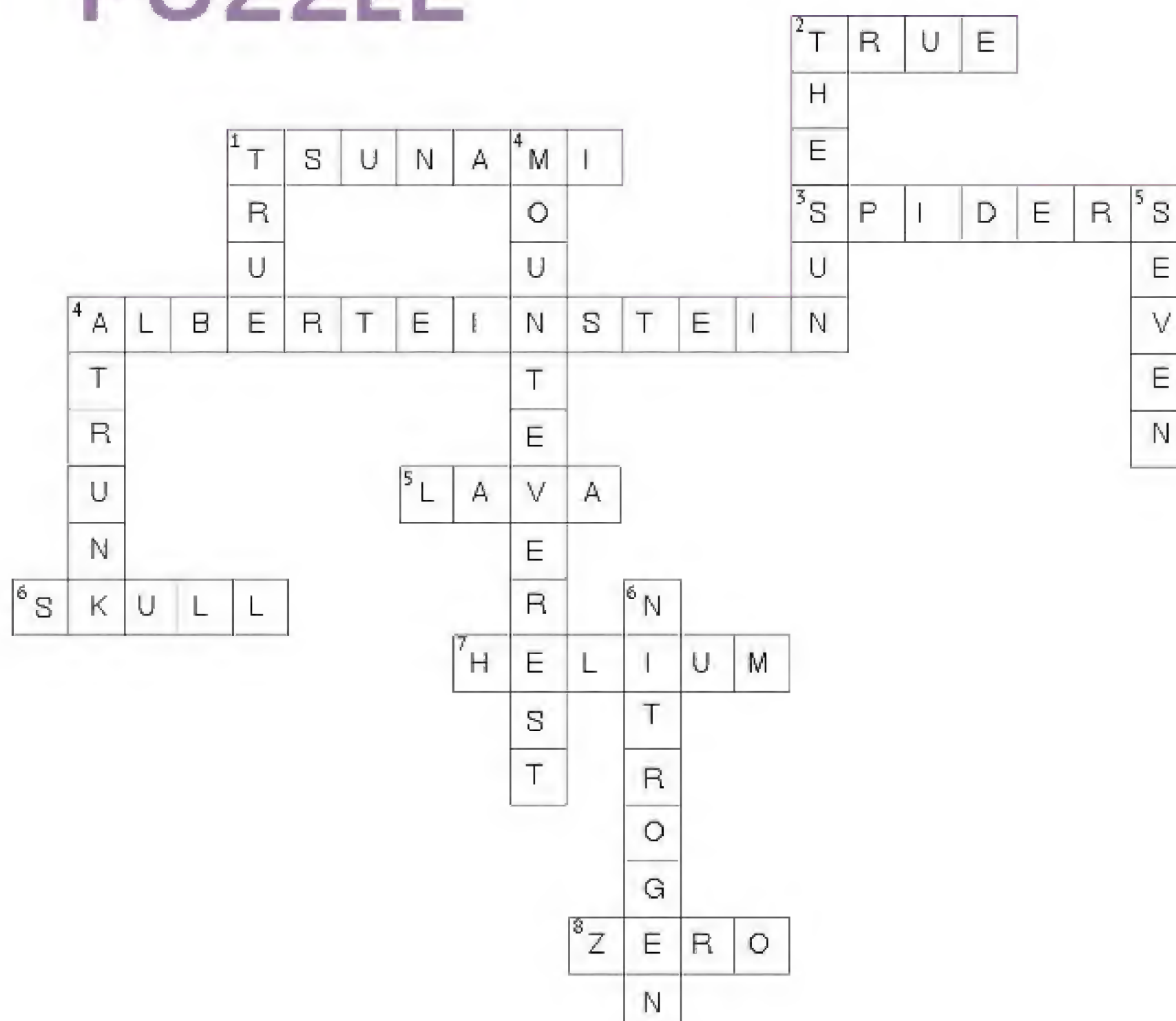
Women in science magazine



WORD SEARCH



CROSSWORD PUZZLE



QUIZ

- 1 Mist is caused by
C. Water vapors at low temperature
- 2 The time taken by the Sun to revolve around the centre of our galaxy is
C. 250 million years
- 3 Given below are the names of four energy crops. Which one of them can be cultivated for ethanol?
B. Maize
- 4 Which one of the following reflects back more sunlight as compared to other three
C. Land covered with fresh snow
- 5 Washing soda is the common name for
C. Sodium carbonate

IDENTITY IS IN THE EYE OF THE BEHOLDER

“Dare to be different, but at the same time,
stay true to yourself.” GUGULETHU MABUZA-HOCQUET

These are very appropriate words indeed from the woman who has committed her research to identity protection. The way Gugulethu Mabuza-Hocquet sees it, your identity is all you really have – and the answer to protecting it, lies in iris biometrics.

Gugu describes the way she ended up in science as a “beautiful accident”. It’s certainly one to be thankful for.

**BRIGHT YOUNG SCIENTISTS BEHIND
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CSIR
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FOR THE GREATER GOOD

International Day for the preservation of the ozone layer commemoration



Dr. Ndarana

The CSIR joined the global community in the annual celebration of the International Day for the preservation of the ozone layer on 16 September 2014. That day, Dr. Thando Ndarana, an atmospheric scientist, presented the findings of the 2014 World Meteorological Organisation (WMO) assessment of ozone depletion in Pretoria, indicating that the recovery of the ozone layer is "significant and exciting to know". The theme for this day of international

importance was: "Ozone layer protection: The mission goes on". The theme highlights the strides made in meeting some of the targets set to phase out ozone depleting substances.

The 1987 Montreal Protocol on substances that deplete the ozone layer successfully led to a halt in the production of chlorofluorocarbons (CFCs) as one of its interventions, and as a result, the ozone layer is expected to recover to pre-1980 levels by the middle of the 2060s. This is the pivotal highlight of the WMO report. The report further states that the ozone layer will recover to the 1980 benchmark levels over most of the globe only under continued compliance with the Montreal Protocol. In a similar vein, future sources of ozone-depleting substances emissions, as highlighted in the report, include: Hydrochlorofluorocarbon production, recoverable banks, and quarantine and pre-shipment-methyl bromide uses. "The ozone layer prevents harmful ultra-violet (UV) rays from reaching the surface of the earth, and so if it has depleted, it is reasonable to hypothesise that this will have serious implications for human health," explained Thando who also serves

as a member of the Science Steering Group of the WMO core project; Stratosphere-troposphere Processes and their role in Climate.

The release of CFCs and other atmospheric pollutants are known to not only deplete the stratospheric ozone, but also to increase human exposure to UV radiation thereby causing skin cancer and cataracts. Thando emphasised that there is international evidence supporting the association between solar UV and various health effects, warning that, "although the ozone layer is beginning to recover, UV radiation remains a health hazard".

Small amounts of UV are essential for the production of Vitamin D in people. UV radiation is also used to treat several diseases, including Rickets, Psoriasis and Eczema; this takes place under medical supervision and the benefits of treatment versus the risks of UV radiation exposure are a matter of clinical judgement. However, prolonged human exposure to solar UV radiation may result in acute and chronic health effects on the skin, eye and immune system. Sunburn and tanning are the best known acute effects of excessive UV radiation exposure.

A THIRST FOR KNOWLEDGE AND EXPERIENCE: PHILA SIBANDZE

They say that hindsight has 20/20 vision.

For Phila Sibandze at SANSA Earth Observation, that means knowing his post-graduate decision to favour spatial information over computer science was “one of the best decisions I have ever made”.

Drawn to the discipline by the opportunity to learn about satellites in space and global positions systems, Phila went on to complete an Honours degree in applied Geographic Information Systems (GIS) and remote sensing. This followed his computer science and GIS Bachelor of Science degree at the University of Fort Hare.

With an insatiable appetite for information, he went on to complete an MSc in environmental science at the University of KwaZulu Natal three years later.

Now Phila spends his day processing satellite images for value added products, as well as overseeing the young and enthusiastic interns at SANSA.

Phila believes there is more to a job than being trained academically. “As they say

in Xhosa, ‘Igqirha lendlela ngu nqonqotwane’ – experience is the master-crafter of one’s skills.” He goes on to explain that remote sensing is an incredibly dynamic discipline. New satellites are always being launched, requiring innovative applications to be developed.

Equally, Phila believes in learning from his colleagues. “The opportunity to travel and broaden my network by interacting with scientists from different backgrounds, and sharing ideas and learning from each other is another attractive aspect of my job.”

With his bank of knowledge and thirst to learn more, Phila says his greatest goal is to be part of a community of scientists that transfer GIS and satellite technology skills to disadvantaged communities. He urges new professionals in the industry to be willing to learn, and bold enough to “express their ideas and raise their concerns”. “These are the building blocks of innovation and knowledge.”



Phila Sibandze

SCIENCE IS FUN!

Knowledge is power



In celebration of World Space Week, SANSA in collaboration with the Secunda Amateur Radio Club and 80 of the areas' top achieving learners; plans on launching two weather balloons to simulate the launch of a satellite. This humble man's private space mission will lift-off from Vryburg on 4 October 2014 with the aim of illustrating the benefits of project-based, science learning activities.

Christo Kriek is the Project Leader and an ardent radio Amateur radio hobbyist. "We (at the Secunda Amateur Radio Club) are passionate about space and believe that knowledge is power," says Kriek. "We are actively involved in launching payloads and then retrieving the payloads once they fall back to Earth," he adds. "The world of science and maths is exciting and the opportunities within these fields are endless. As professionals, it is important for us to expose learners to the fun-side of technology."

Representatives from the South African

National Space Agency (SANSA) will set up a mobile ground station in Secunda; and make use of the existing Cubesat ground station in Hartebeesthoek, to track the balloons with the learners and collect real-time data from the payloads as they ascend. "One of SANSA's strategic objectives is to develop human capital in terms of science advancement and outreach activities," explains Eugene Avenant, Chief Engineer at SANSA Space Operations. "This mission is an exciting one for us too, as we too look forward to making use of the data captured." As this coincides with the introduction of World Space Week, SANSA envisages having a live streaming of the launch from Vryburg to Secunda; and to the SANSA ground station in Hartebeesthoek.

"The 4 October coincides with the launch of Sputnik 1 (the first artificial Earth satellite), 57 years ago and we will have a scale model transmitting a Morse code message from the payload," adds Kriek.



To avoid interference with any aircraft, the Central Airspace Management Unit (CAMU) has granted us a slot in Vryburg, between 06:00-08:00 to commence flight. "It is a challenge for us to transport all team members to Vryburg. If we cannot get everyone



to Vryburg, we will do our best to get Vryburg to them." The Secunda Amateur Radio Club/SANSA team is looking at using Social Media to make this possible.

The following sensors will be carried on the two balloons: humidity, light intensity, temperature, barometric pressure, UV, Geiger counter and several GPS instruments. In addition, a video camera and still camera will be added to the mix. "We plan on gathering as much data as possible," explains Kriek. "The payload should travel at least 32km high which will expose the learners to space-like conditions." Teams will be made up of 10 learners each. The mission involves program-

ming a data logger and building it into a 100mmx100mmx100mm container and then deciding on the project outcome – what information they foresee using – in other words, what sensors' data each team would like to make use of for their research project.

"This is an ideal way of presenting science and technology in a hands-on manner, while achieving the necessary learning outcomes. At SANSA Space Operations, we will endeavour to partake in more of these type of initiatives," concludes Avenant. A second test-run will be conducted by the team this weekend.

Side bar

SANSA aims to leverage the benefits of space science and technology for socio-economic development, environmental conservation and natural resource management. The consolidation of South Africa's primary space entities under one banner has brought together a significant range of competencies in satellite applications, satellite engineering and research in space science and technology to play an important role in the country's future space initiatives. The space agency is also committed to delivering quality services to the international space sector and growing its Earth observation data management capability.

SANSA Space Operations

The SANSA Space Operations directorate, formerly the CSIR Satellite Applications Centre (SAC), is a key component in the implementation of South Africa's National Space Strategy. Ideally located at Hartebeesthoek in South Africa's Magaliesberg mountain range on the outskirts of the Cradle of Humankind World Heritage site, SANSA Space Operations provide tracking, telemetry and command (TT&C) services for geosynchronous and polar-orbiting spacecraft to the manufacturers, operators and users of satellites and launch vehicles, as well as for satellite data acquisition.

For more information on the project, go to www.secradio.org.za or <http://habspace.net/blog/>.

ASTRO FACTS "PLANETS..."

The Sun

The Sun takes approximately 365 days to travel through the Zodiac

Fire is his element. His nature is hot and dry. He rules Leo

He represents the father.

Characterology: He is passionate.

The Moon

The Moon is the swiftest of all, she travels through the Zodiac
Water is her element. Her nature is cold and moist. She rules Cancer.

She represents the mother.

Characterology: She is nervous.

Mercury

Mercury's revolution takes about 88 days.

Earth is his element. His nature is cold and dry. He rules Virgo and Gemini.

He represents traders and attorneys.

Characterology: He is nervous

Venus

Venus' cycle is variable. She takes approximately 225 days to travel through the Zodiac.

Air is her element. Her nature is moist. She rules Taurus and Libra.

She represents artists and all occupations related to beauty.

Characterology: non-active

Mars

This quite small planet travels through the Zodiac in 1 year and 220 days.

Fire is his element. His nature is hot and dry. He rules Aries

Mars represents the warriors and sportsmen.

Characterology: He is a choleric.

Jupiter

Jupiter is the first slow-moving planet, the biggest of the solar system, and twelve times the size of the Earth. He takes nearly twelve years to travel through the Zodiac.

Air is his element. His nature is hot and moist. He rules Sagittarius and Pisces.

Characterology: He is an extrovert

Saturn

Saturn takes about 29 years to travel through the Zodiac

Earth is his element. His nature is cold and dry. He rules Capricorn and Aquarius.

Characterology: He is sentimental.

Uranus

Uranus takes 84 years to travel through the Zodiac

Fire is his element. His nature is dry. He rules Aquarius

He represents inventors.

Characterology: He is passionate.

Neptune

Neptune takes approximately 168 years to travel through the Zodiac.

Water is his element. His nature is humid. He rules Pisces

He represents dreamers and magicians.

Characterology: He is sentimental.

Pluto

Pluto takes approximately 254 years to travel through the Zodiac.

His element is undefined. His nature is burning. He rules Scorpio.

He represents dictators and powerful people.

Characterology: He is passionate.



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SCIENCESTARS 

WOMAN TAKE CHARGE OF YOUR LIFE!

Believing in what seems impossible

Alice in Wonderland is one of my favourite books. I've always been in love with the story.

As I got older, I realised that my world had quite a bit of nonsense in it as well and I wondered if, perhaps, I was already down the rabbit hole. Everything about the world - both Alice's and my own - fascinated me and confused me.

This is a piece directed to you, special and phenomenal women.

It is easy to think that Alice in Wonderland is a dreamland fairy tale for children.

On the surface it appears to be just that.

However, if you look closer, you will realise

that Alice's world translates into much more than a children's fairytale.

Growing up you would have realised that, like Alice, you can't seem to come to terms with the world around you. It is an interesting place, yes, but also unnerving at times.

Here are some of the lessons from Alice in Wonderland, I hope you will read them and learn from them just as I've been doing all these years.

Lesson1: Decide where you want to go

"Would you tell me, please, which way I ought to go from here?" "That depends a good deal on where you want to go," said the Cat. "I don't much care where" said Alice.

"Then it doesn't much matter which way you go," said the Cat. "So long as I get somewhere," Alice added as an explanation.

"Oh, you're sure to do that," said the Cat, "if you only walk long enough."

Do you know where you want to go in life? You will end up somewhere, but figure out what your path is and get on it! And remember: No one but you can point you in the direction or path that is right for you. It's up to you to find your path and start moving in the right direction. It's never easy and I've certainly had some help from amazing people in my life, but it

was ultimately up to me to get on the right path - and stay there. If you don't know what your path is, give it some serious thought. If you are already on the best path for you, keep moving!

Lesson2: Stop doing things that get you nowhere.

"It takes all the running you can do, to keep in the same place."

The Red Queen

Do you want your life to change but you keep doing the same things over and over again? Listen to the Queen. Sometimes - okay, often - it feels easier to keep doing what you've been doing because it's comfortable. We can get so set in our ways, in rationalising our behaviour to make it seem okay, but we're actually making things a lot harder on ourselves. Just think about your life for a minute. Are you putting yourself in positions where you have to compromise yourself because it seems easier? Remember what the Queen said and remember this: don't ever, ever settle for less than what you deserve in life.

Lesson3: Believe in what seems impossible.

"There's no use in trying," Alice said, "one can't believe impossible things." "I dare say you haven't had much practice," said the Queen.

"When I was your age, I always did it for



half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast."

How many of us are like Alice, so certain that something is impossible that we don't even give it a try? People who succeed in life do so because they try and because they have a good attitude. They make an effort. They do, rather than just thinking about doing. This is hard though. Trust me, I know. You have to believe that things that might seem impossible are possible. No matter what your dreams are, no matter what you envision for your life, you can make it happen. It won't always come easily, but you have to believe.

Lesson4: Figure out who you are.

"Dear, dear! How queer everything is today! And yesterday things went on just as usual.

I wonder if I've changed in the night. Let me think...was I the same when I got up this morning?

I almost think I can remember feeling a little different. But if I'm not the same, the next question is 'Who in the world am I?' Ah, that's the great puzzle!"

Alice

Who are you? Ah, the great and mind-boggling question. I'm not sure anyone really 100% knows who they are (or even really will), but I do believe that some of us have a better idea than others.

As unsettling as life can sometimes be, if you know who you are, you have a foundation on which to always rest. You can be certain in one thing: yourself. Knowing who you are will keep you sane and help you to grapple with whatever curve balls life throws at you.

Lesson5: Communicate carefully with others.

"You should say what you mean," the March Hare went on.

"I do," Alice hastily replied. "At least I mean what I say.

That's the same thing you know?"

You should think about this: Do you really say what you mean? Do you really mean what you say? Communication, for me, is tough. It's important to mean what you say. When you tell someone something, mean it. Don't just speak to speak. It can be hard to communicate with others. However, I've found that if you take the time to really think about what you want to say and if you really mean the words that come out of your mouth, things in life go a lot more smoothly.

Cheers until next time

Donavon



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Physical Science 60%

NBT in Mathematics, AL & QL to be written

UNIVERSITY OF THE WITSWATERSRAND JOHANNESBURG

ADMISSION REQUIREMENTS: BSc Astronomy

English HL Level 5

Mathematics Level 6

Physical Science Level 7

UNIVERSITY OF SOUTH AFRICA

ADMISSION REQUIREMENTS: Astronomy

A minimum of 96 credits at NQF level 8 with an average of 60%

UNIVERSITY OF FREE STATE

ADMISSION REQUIREMENTS: Bsc Astrophysics

NSC + AP (30)

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Mathematics level 5 (60%) Alternatively (senior students) at least a pass mark in WTW164 or WTW194 or WTV184 is required. If WKS114 or WTW114 is included in the learning programme a level 6 (70%) and a level 7 (80%), respectively, for mathematics is required. Alternatively (senior students)

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I WORKED HARD.

“ At my math and science. And it paid off. SANRAL’s scholarship programme is helping me to pay for my schooling to pave the way for my success. ”

Seokedzi Mothokwa is just one of the 179 learners that SANRAL’s scholarships from 2012-2013 is helping to realize his dreams of doing well and going on to study at university.

It’s an investment for us, for him and for our country. Who knows what he may become – but we know that better education means more opportunities, and that means a better nation for us all.

WE KNOW THAT BECAUSE WE’RE GOOD AT CONNECTING THINGS

Periodic Table of Elements

1 IA Hydrogen H 1.0079	2 IIA Lithium Li 6.939	3 Sodium Na 22.990	4 Potassium K 39.098	5 Rubidium Rb 85.468	6 Caesium Cs 132.91	7 Francium Fr 223	18 VIII Helium He 4.0026	17 VIIA Fluorine F 18.998	16 VIA Oxygen O 15.999	15 VA Nitrogen N 14.007	14 IVA Carbon C 12.011	13 IIIA Boron B 10.811	12 IIB Zinc Zn 65.39	11 IB Copper Cu 63.546	10 VIII Nickel Ni 58.693	9 VIII Cobalt Co 58.933	8 VIII Iron Fe 55.845	7 VIIB Manganese Mn 54.938	6 VIB Chromium Cr 51.996	5 VB Vanadium V 50.942	4 IVB Titanium Ti 47.867	3 IIIB Scandium Sc 44.956	2 Yttrium Y 88.906	1 Lanthanum La 138.91	103 Lawrencium Lr 262	102 Nobelium No 259	101 Mendelevium Md 258	100 Fermium Fm 257	99 Einsteinium Es 252	98 Californium Cf 251	97 Berkelium Bk 247	96 Curium Cm 247	95 Americium Am 243	94 Plutonium Pu 244	93 Neptunium Np 237	92 Uranium U 238.03	91 Protactinium Pa 231.04	90 Thorium Th 232.04	89 Actinium Ac 227	71 Lutetium Lu 174.96	70 Ytterbium Yb 173.04	69 Thulium Tm 168.93	68 Erbium Er 167.26	67 Holmium Ho 164.93	66 Dysprosium Dy 162.5	65 Terbium Tb 158.93	64 Gadolinium Gd 157.25	63 Europium Eu 151.96	62 Samarium Sm 150.36	61 Promethium Pm 145	60 Neodymium Nd 144.24	59 Praseodymium Pr 140.91	58 Cerium Ce 140.12	57 Lanthanum La 138.91	223 Francium Fr 223	226 Radium Ra 226	208 Polonium Po 208	210 Astatine At 210	212 Nihonium Nh 212	214 Moscovium Mc 214	216 Livermorium Lv 216	218 Oganesson Og 218	220 Unbinoidium Ubn 220	222 Copernicium Cn 222	224 Flerovium Fl 224	226 Tennessine Ts 226	228 Oganeson Og 228	230 Unbinoidium Ubn 230	232 Unbinoidium Ubn 232	234 Unbinoidium Ubn 234	236 Unbinoidium Ubn 236	238 Unbinoidium Ubn 238	240 Unbinoidium Ubn 240	242 Unbinoidium Ubn 242	244 Unbinoidium Ubn 244	246 Unbinoidium Ubn 246	248 Unbinoidium Ubn 248	250 Unbinoidium Ubn 250	252 Unbinoidium Ubn 252	254 Unbinoidium Ubn 254	256 Unbinoidium Ubn 256	258 Unbinoidium Ubn 258	260 Unbinoidium Ubn 260	262 Unbinoidium Ubn 262	264 Unbinoidium Ubn 264	266 Unbinoidium Ubn 266	268 Unbinoidium Ubn 268	270 Unbinoidium Ubn 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Unbinoidium Ubn 686	688 Unbinoidium Ubn 688	690 Unbinoidium Ubn 690	692 Unbinoidium Ubn 692	694 Unbinoidium Ubn 694	696 Unbinoidium Ubn 696	698 Unbinoidium Ubn 698	700 Unbinoidium Ubn 700	702 Unbinoidium Ubn 702	704 Unbinoidium Ubn 704	706 Unbinoidium Ubn 706	708 Unbinoidium Ubn 708	710 Unbinoidium Ubn 710	712 Unbinoidium Ubn 712	714 Unbinoidium Ubn 714	716 Unbinoidium Ubn 716	718 Unbinoidium Ubn 718	720 Unbinoidium Ubn 720	722 Unbinoidium Ubn 722	724 Unbinoidium Ubn 724	726 Unbinoidium Ubn 726	728 Unbinoidium Ubn 728	730 Unbinoidium Ubn 730	732 Unbinoidium Ubn 732	734 Unbinoidium Ubn 734	736 Unbinoidium Ubn 736	738 Unbinoidium Ubn 738	740 Unbinoidium Ubn 740	742 Unbinoidium Ubn 742	744 Unbinoidium Ubn 744	746 Unbinoidium Ubn 746	748 Unbinoidium Ubn 748	750 Unbinoidium Ubn 750	752 Unbinoidium Ubn 752	754 Unbinoidium Ubn 754	756 Unbinoidium Ubn 756	758 Unbinoidium Ubn 758	760 Unbinoidium Ubn 760	762 Unbinoidium Ubn 762	764 Unbinoidium Ubn 764	766 Unbinoidium Ubn 766	768 Unbinoidium Ubn 768	770 Unbinoidium Ubn 770	772 Unbinoidium Ubn 772	774 Unbinoidium Ubn 774	776 Unbinoidium Ubn 776	778 Unbinoidium Ubn 778	780 Unbinoidium Ubn 780	782 Unbinoidium Ubn 782	784 Unbinoidium Ubn 784	786 Unbinoidium Ubn 786	788 Unbinoidium Ubn 788	790 Unbinoidium Ubn 790	792 Unbinoidium Ubn 792	794 Unbinoidium Ubn 794	796 Unbinoidium Ubn 796	798 Unbinoidium Ubn 798	800 Unbinoidium Ubn 800	802 Unbinoidium Ubn 802	804 Unbinoidium Ubn 804	806 Unbinoidium Ubn 806	808 Unbinoidium Ubn 808	810 Unbinoidium Ubn 810	812 Unbinoidium Ubn 812	814 Unbinoidium Ubn 814	816 Unbinoidium Ubn 816	818 Unbinoidium Ubn 818	820 Unbinoidium Ubn 820	822 Unbinoidium Ubn 822	824 Unbinoidium Ubn 824	826 Unbinoidium Ubn 826	828 Unbinoidium Ubn 828	830 Unbinoidium Ubn 830	832 Unbinoidium Ubn 832	834 Unbinoidium Ubn 834	836 Unbinoidium Ubn 836	838 Unbinoidium Ubn 838	840 Unbinoidium Ubn 840	842 Unbinoidium Ubn 842	844 Unbinoidium Ubn 844	846 Unbinoidium Ubn 846	848 Unbinoidium Ubn 848	850 Unbinoidium Ubn 850	852 Unbinoidium Ubn 852	854 Unbinoidium Ubn 854	856 Unbinoidium Ubn 856	858 Unbinoidium Ubn 858	860 Unbinoidium Ubn 860	862 Unbinoidium Ubn 862	864 Unbinoidium Ubn 864	866 Unbinoidium Ubn 866	868 Unbinoidium Ubn 868	870 Unbinoidium Ubn 870	872 Unbinoidium Ubn 872	874 Unbinoidium Ubn 874	876 Unbinoidium Ubn 876	878 Unbinoidium Ubn 878	880 Unbinoidium Ubn 880	882 Unbinoidium Ubn 882	884 Unbinoidium Ubn 884	886 Unbinoidium Ubn 886	888 Unbinoidium Ubn 888	890 Unbinoidium Ubn 890	892 Unbinoidium Ubn 892	894 Unbinoidium Ubn 894	896 Unbinoidium Ubn 896	898 Unbinoidium Ubn 898	900 Unbinoidium Ubn 900	902 Unbinoidium Ubn 902	904 Unbinoidium Ubn 904	906 Unbinoidium Ubn 906	908 Unbinoidium Ubn 908	910 Unbinoidium Ubn 910	912 Unbinoidium Ubn 912	914 Unbinoidium Ubn 914	916 Unbinoidium Ubn 916	918 Unbinoidium Ubn 918	920 Unbinoidium Ubn 920	922 Unbinoidium Ubn 922	924 Unbinoidium Ubn 924	926 Unbinoidium Ubn 926	928 Unbinoidium Ubn 928	930 Unbinoidium Ubn 930	932 Unbinoidium Ubn 932	934 Unbinoidium Ubn 934	936 Unbinoidium Ubn 936	938 Unbinoidium Ubn 938	940 Unbinoidium Ubn 940	942 Unbinoidium Ubn 942	944 Unbinoidium Ubn 944	946 Unbinoidium Ubn 946	948 Unbinoidium Ubn 948	950 Unbinoidium Ubn 950	952 Unbinoidium Ubn 952	954 Unbinoidium Ubn 954	956 Unbinoidium Ubn 956	958 Unbinoidium Ubn 958	960 Unbinoidium Ubn 960	962 Unbinoidium Ubn 962	964 Unbinoidium Ubn 964	966 Unbinoidium Ubn 966	968 Unbinoidium Ubn 968	970 Unbinoidium Ubn 970	972 Unbinoidium Ubn
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